

DPR's Investigation of Antifouling Paint Pollution



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Overview of Presentation

- Presented to PREC back in late 2004
- Brief recap of history & background
- Overview of issues & activities from 2004 to present
- Summary of statewide monitoring study & results
- Next steps - Timeline

History of Cu AFP Issues in CA

- Tri-butyl Tin to Copper
- Shelter Island Yacht Basin (SIYB) CWA 303(d) list & TMDL
- International AFP Workshop
- Advisory Committee for Environmentally-Superior Antifouling Paint (SB 315)
- Copper Summit Workshop 🕒 Cu AFP Sub-Workgroup

Copper Antifouling Paint Sub-Workgroup

- Sub-workgroup of the NPS IACC Marina & Recreational Boating Workgroup
- Copper Sub-Group (CSG)
- Meets bi-monthly in Cal-EPA Building in Sacramento (13th meeting)
- Interagency participation from State & Regional Boards & many other agencies (e.g., U.S. EPA, CCC, UC Sea Grant, DBW, Navy, DTSC)

Copper Antifouling Paint Sub-Workgroup

- Goal: To assess the geographical distribution & magnitude of Cu pollution from AFP use in California to facilitate the evaluation of mitigation options by DPR & the Water Boards
- Started as Cu interagency group but increased public participation & expanded workgroup scope

Copper Antifouling Paint Sub-Workgroup

Objectives:

- Identify existing studies & information
- Seek opportunities to collaborate on current & future studies
- Share & disseminate data/information w/ participating agencies

More Recent AFP Issues & Activities

- EU Biocidal Directive
- European restrictions
- U.S. EPA Reregistration
- NPDES permits for boat discharges
- UNDS regulations for military vessel discharges
- Changes to Federal W.Q. Criteria
- Aquatic Invasive Species concern

More Recent AFP Issues & Activities

- New 2006 CWA 303(d) listings
- Lower Newport Bay & Marina del Rey TMDLs
- Feasibility studies of alternatives
- Toxicity of alternative biocides
- Passive leaching vs. in-water hull cleaning
- Implementation of SIYB TMDL
- Development of DPR AFP Strategy – framework for internal evaluation

Monitoring Studies

- Still the focal point of CSG
- Supported & tracked studies
 - SCCWRP/SDRWQCB South Coast study
 - SDRWQCB San Diego Bay survey
 - DBW SIYB Biological Effects study
- Planned and coordinated on several regional & statewide studies
 - DPR/SARWQCB Lower Newport Bay study
 - DPR/SWRCB Statewide monitoring study

DPR/SWRCB Statewide AFP Monitoring Study

- DPR-led effort w/ funding support from SWRCB & U.S. EPA
- Planned w/ assistance from CSG
- Worked w/various boating & marina stakeholder groups
- Monitoring Plan & Quality Assurance Project Plan

Statewide Study Objectives

■ Objectives:

- Determine occurrences & concentrations of AFP active ingredients (i.e., Cu, Zn, and Irgarol) in water & sediment at a number of marina areas
- Determine if concentrations of AFPs in marinas are significantly higher than those in local reference sites.
- Determine if there are differences in AFP levels among fresh, brackish, & salt water marinas.

Statewide Study Objectives

■ Objectives (Cont.)

- Estimate bioavailability & toxicity of Cu using U.S. EPA's Biotic Ligand Model (BLM)
- Measure toxicity of marina waters at a subset of sites & identify the likely cause of observed toxicity using TIE procedures.

Analytes of Interest

■ For Water:

- Dissolved Cu & Zn
- Total Cu
- Total Suspended Solids (TSS)
- Irgarol 1051 (subset of sites)
- Water Column Toxicity (subset of sites)
- BLM Associated parameters: Calcium, Potassium, Magnesium, Sodium, Alkalinity, Chloride, Sulfate, Dissolved Organic Carbon, Temperature, pH

■ For Sediment*:

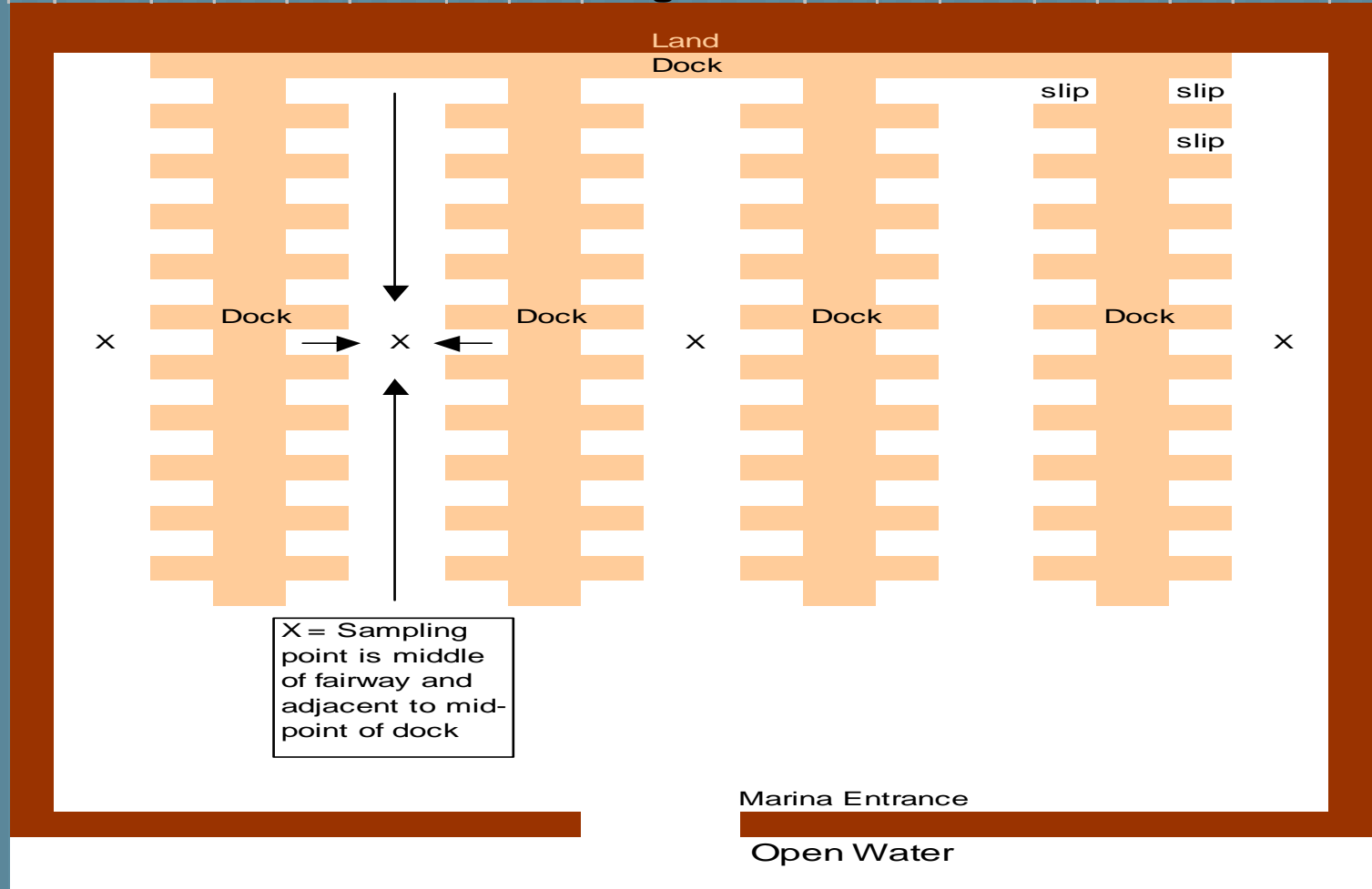
- Total Cu & Zn
- Total Organic Carbon
- Grain Size

General Study Design

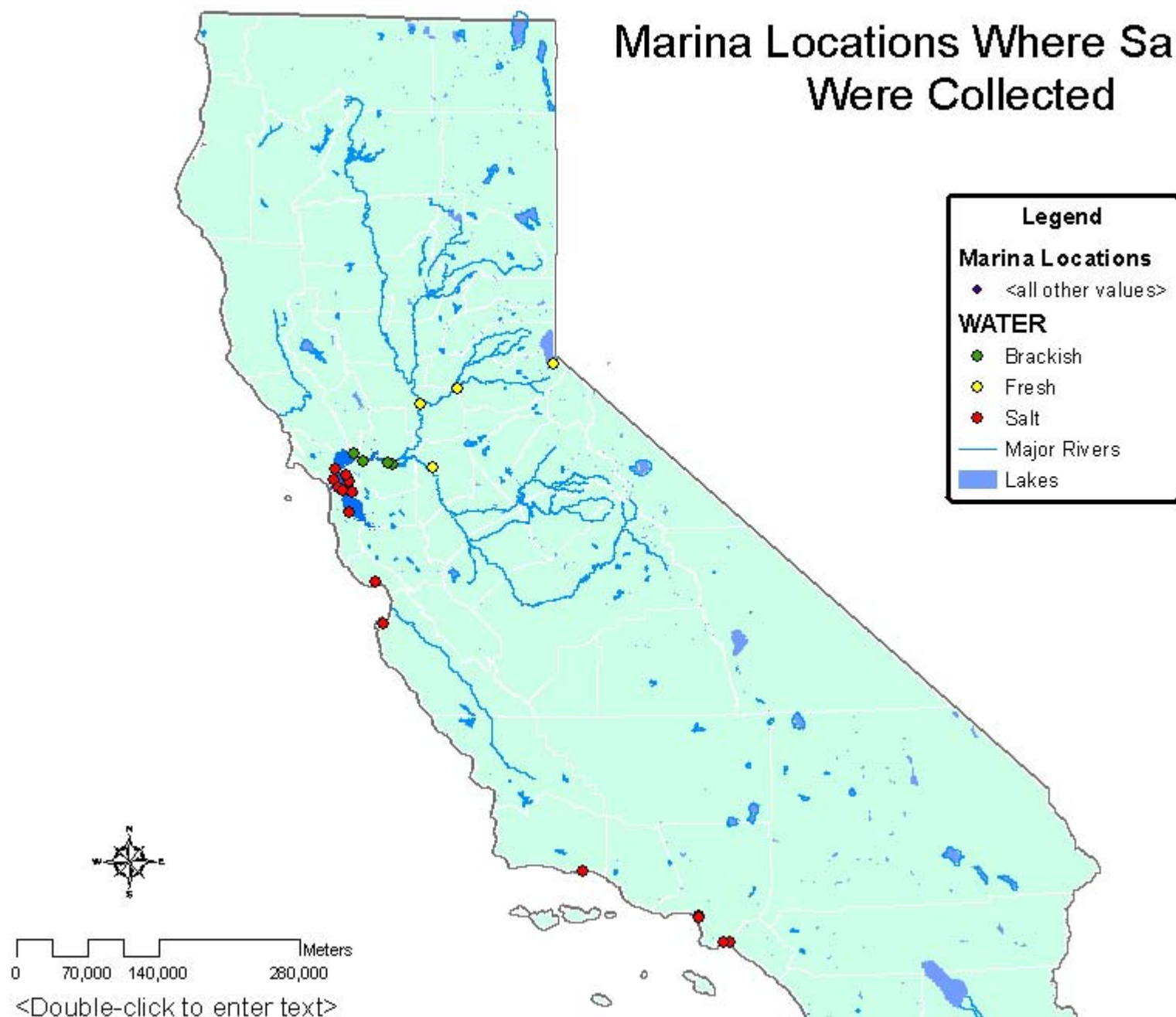
- Selected 23 (medium – large) CA marinas
- Avoided marinas w/ potential interferences from confounding sources
- Sampled each marina 3 times over the summer period (July – October 2006)
- Water and sediment from 4 points inside marina area & 4 points outside of the marina area (local reference sites)
- Took sub-surface samples from center of fairway & half way down docks

General Marina Diagram

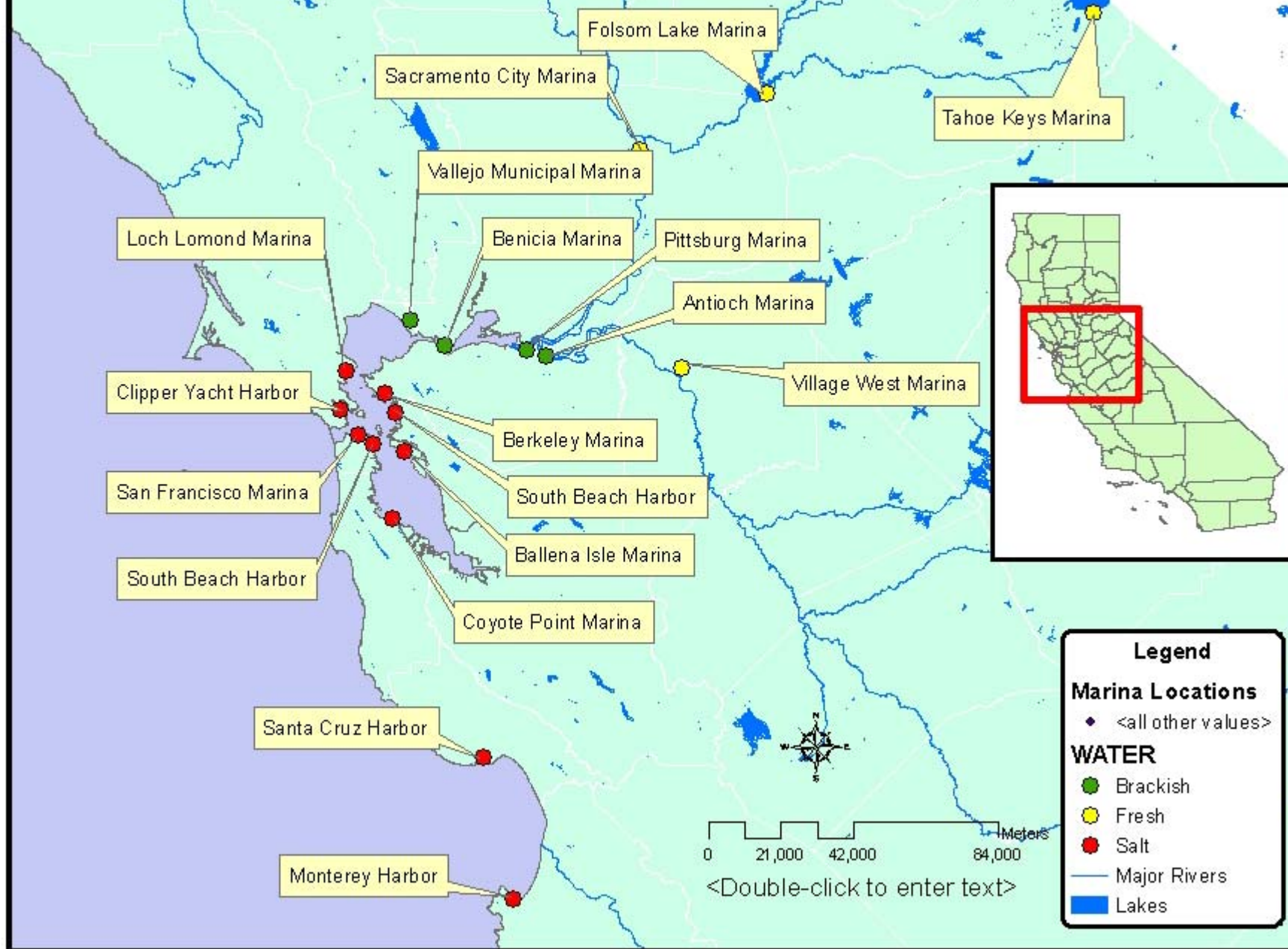
Diagram 1



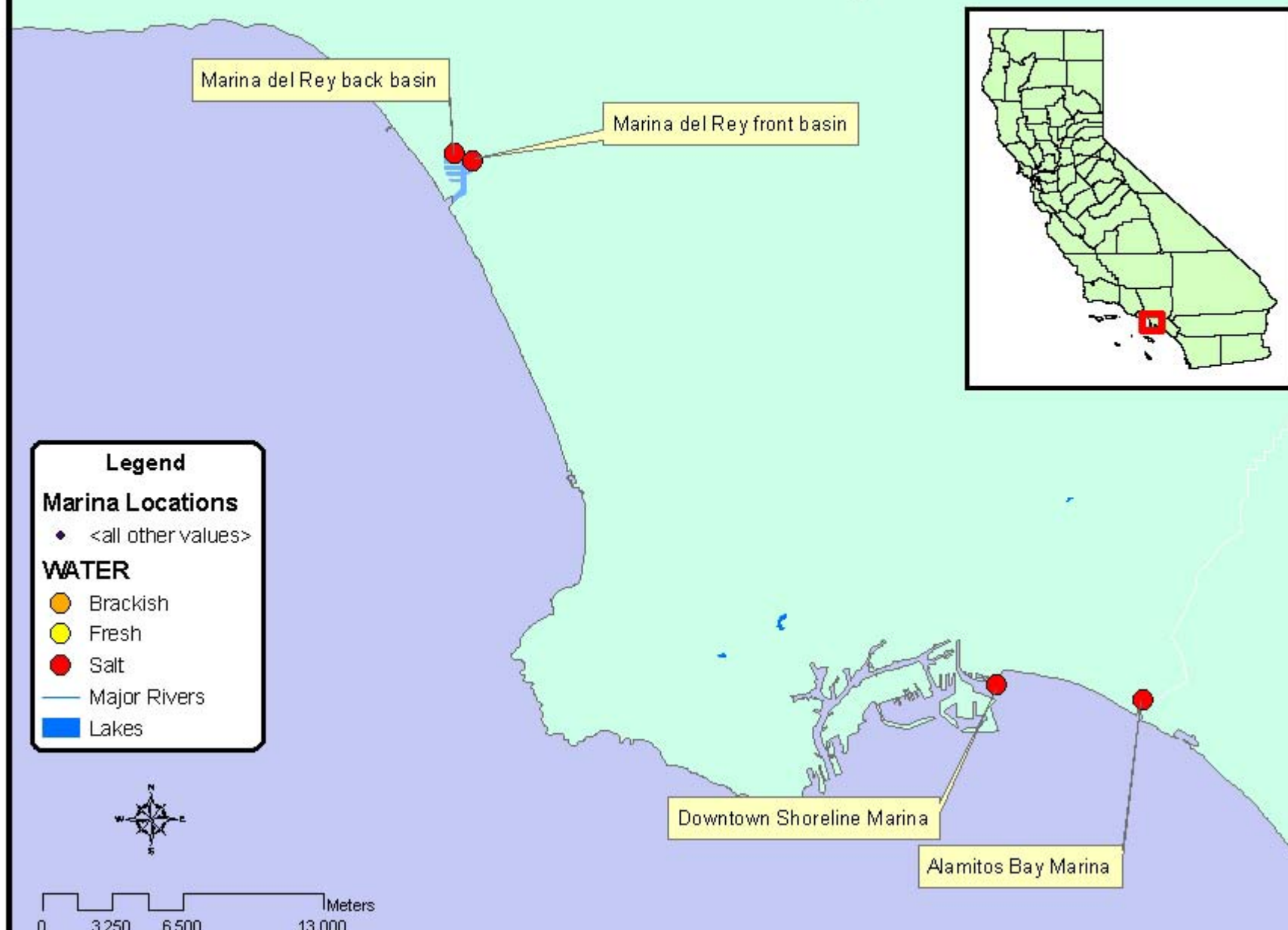
Marina Locations Where Samples Were Collected



Northern Marina Locations Where Samples Were Collected



Southern Marina Locations Where Samples Were Collected





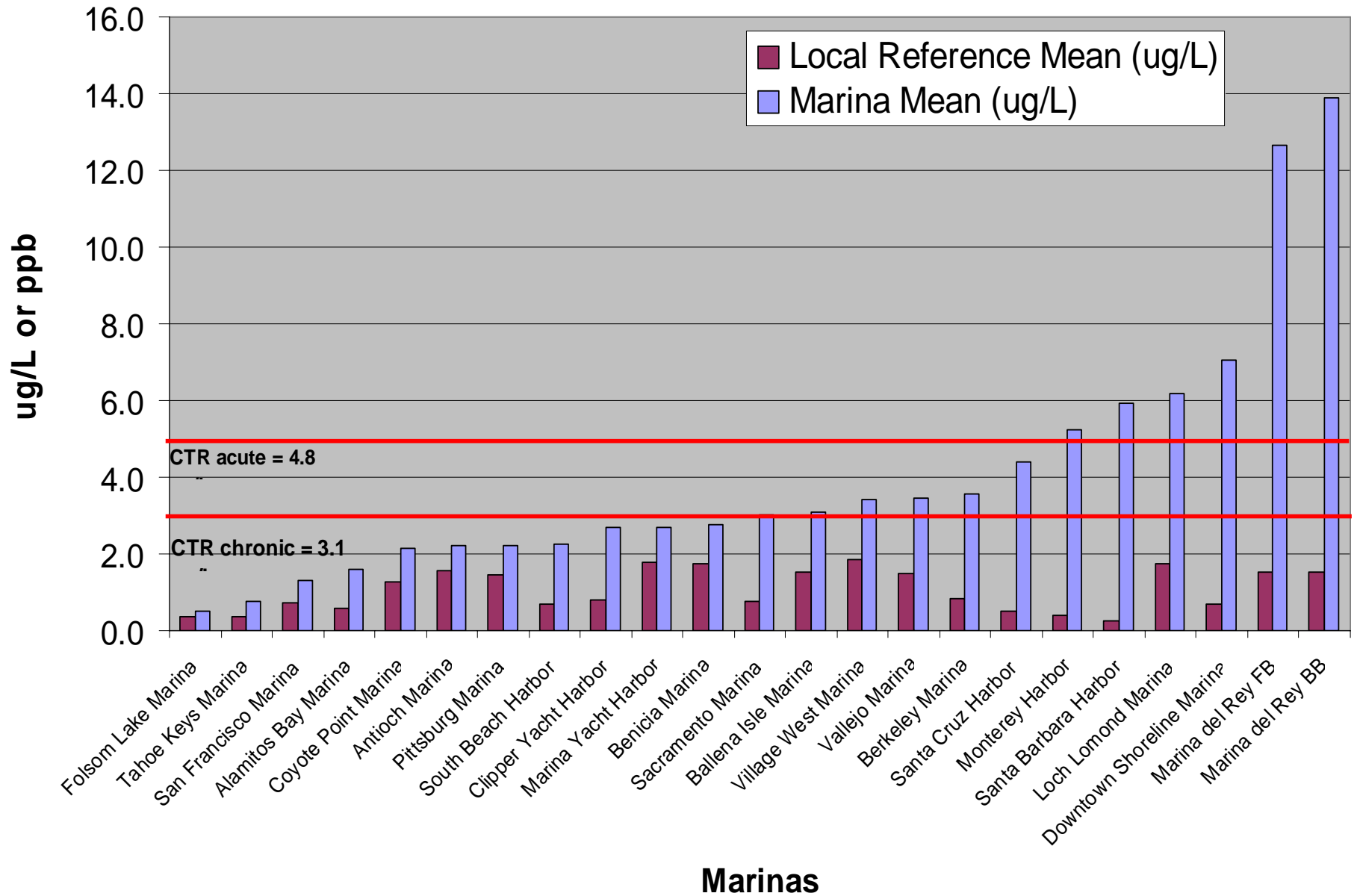
Statewide AFP Study: Preliminary Results											
<i>Marina</i>	<i>Number of Slips</i>	<i>x of 3</i>	<i>Cu Marina Mean (ug/L)</i>	<i>Marina Std. Dev. (ug/L)</i>	<i>Cu Local Reference Mean (ug/L)</i>	<i>Local Reference Std. Dev. (ug/L)</i>	<i>Toxicity</i>	<i>Irgarol 1 (ng/L) 1st Round</i>	<i>Irgarol 2 (ng/L) 2nd Round</i>		
Folsom Lake Marina	675	3	0.5	0.1	0.4	0.1					
Tahoe Keys Marina	250	2	0.8	0.1	0.4	0.4					
San Francisco Marina	700	3	1.3	0.9	0.7	0.2	T	42.9	16.6		
Alamitos Bay Marina	1,191	3	1.6	1.1	0.6	0.4	T	36.8	18.2		
Coyote Point Marina	565	2	2.2	0.3	1.3	0.1					
Antioch Marina	310	3	2.2	0.4	1.6	0.1					
Pittsburg Marina	486	3	2.2	0.6	1.5	0.1	T	21.3	66.5		
South Beach Harbor	700	3	2.3	0.3	0.7	0.2	T	62.1	97.3		
Clipper Yacht Harbor	735	3	2.7	1.5	0.8	0.3					
Marina Yacht Harbor	850	3	2.7	0.5	1.8	0.4	T	92.1	124.8		
Benicia Marina	320	3	2.8	0.5	1.8	0.2	T	46.1	29.3		
Sacramento Marina	547	3	3.0	0.6	0.8	0.5					
Ballena Isle Marina	504	3	3.1	1.2	1.5	0.9		115.0	66.2		
Village West Marina	700	3	3.4	0.3	1.9	0.5					
Vallejo Marina	800	3	3.5	0.8	1.5	0.2	T	26.1	33.2		
Berkeley Marina	1,052	3	3.6	1.4	0.8	0.5	T (low)	68.1	158.3		
Santa Cruz Harbor	1,000	3	4.4	0.9	0.5	0.2					
Monterey Harbor	413	3	5.2	1.8	0.4	0.1					
Santa Barbara Harbor	1,133	3	5.9	1.6	0.3	0.1					
Loch Lomond Marina	517	3	6.2	2.2	1.8	0.3	T	272.3	414.9		
Downtown Shoreline Marina	1,800	3	7.1	2.3	0.7	0.3	T				
Marina del Rey FB	~ 5000	3	12.7	2.0	1.5	1.6					
Marina del Rey BB	~ 3000	3	13.9	3.1	1.5	1.6	T (high)	120.3	111.8		

	freshwater marinas	100% completeness	T = toxicity samples taken
	brackish marinas	CTR chronic criterion = 3.1 ug/L	denotes statistically significant toxicity
	saltwater marinas	CTR acute criterion = 4.8 ug/L	

Water column toxicity is developmental toxicity test on mussel embryo (*Mytilus galloprovincialis*)

Irgarol:	50 ng/l inhibit growth green macroalga <i>Enteromorpha intestinalis</i>
	100 ng/L lowest EC50 for aquatic plants
	136 ng/l reduces growth and productivity of sensitive phytoplankton species such as the diatom <i>Navicula pelliculosa</i>
	200 ng/l decrease in periphyton photosynthetic activity

Preliminary Dissolved Cu Results



Observations from Results

- Dis. Cu data are generally within expected range for fresh, brackish, & salt water marinas. Likely correlated to relative use & site-specific flushing
- Many marina samples exceeded CTR W.Q. standards for dissolved Cu
- Dis. Cu levels comparable to other recent marina copper & toxicity studies for South Coast, Lower NPB, & San Diego Bay

Observations from Results (cont.)

- Occurrence of toxicity consistent w/ SCCWRP 2005 study & protective nature of WQC
- Marina conc. almost always higher than local reference conc. – marinas are “hot spots” and source likely from boats
- Zn below CTR standards
- Irgarol & metabolites ubiquitous
- MdR levels very high. Toxicity observed

Next Steps – Timeline

■ By September 2007

- Complete evaluation of statewide study data (report due December 2007)
- Evaluate all currently available AFP data & information
- Formulate registration, regulatory, policy, mitigation decisions (if any)

■ In September 2007

- Report to SWRCB Management

■ After September 2007

- Publicly announce decisions
- Implement DPR actions
- Also continue long-term AFP Strategy



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